usually contains octahedral crystals, but sometimes crystalline needles. According to our experiments, octahedra are much more likely to be present than needles; the opposite result, however, is stated by several writers.

Our experience has confirmed the observation first made by Mitcherlich, that when a solution of tartar emetic is decomposed by excess of ammonia, the precipitated antimonic oxide is after a time converted, in part at least, into minute octahedra.

Another fallacy that may be mentioned in this connection, although first pointed out some years since by Reinsch, is that of *sulphurous acid.* If this acid, either in its free state or as an alkaline sulphite, be present with bright copper foil, on heating the acidulated mixture, or even if sulphurous acid be present in comparatively large quantity, without the application of heat, the copper receives a deposit or coating which in appearance may not be unlike that produced by arsenic. This coating may, after a time, become detached in the form of metallic-like flakes. We find these detached flakes to be a definite sulphuret of copper in the proportion of two atoms of the metal with one atom of sulphur, Cu_2S.

If the coated copper be heated in a reduction-tube, a portion of the sulphur may be volatilized and condense in the upper portion of the tube. In no instance, however, did we obtain a sublimate that could be mistaken for that from arsenic by an observer having even only a limited experience with the appearance of the arsenical sublimate.

Since sulphurous acid is frequently employed in the examination of suspected organic mixtures as a reducing agent, it is important to bear in mind that the acid may thus produce a deposit on copper; especially as a sulphur deposit of this kind may greatly interfere with obtaining satisfactory results from arsenic itself when present only in minute quantity.

When present in its free state, sulphurous acid is rather readily expelled from a solution by heat; but when present as an alkaline sulphite, it requires the prolonged action of heat for its entire expulsion, even in the presence of a free mineral acid.

PHILADELPHIA, Sept. 1, 1877.

ARTICLE VIII.

A CONTRIBUTION TO THE ANATOMY OF THE HUMAN RETINA.

By W. F. NORRIS, A.M., M.D., Clinical Professor of Ophthalmology in the University of Pennsylvania, and E. O. SHAKESPEARE, A. M., M.D., Lecturer on Refraction and Accommodation and Operative Ophthalmic Surgery in the University of Pennsylvania.

THE complicated structure of the retina, and its rapid change and disorganization after death have, ever since the introduction of the microscope in medicine, rendered it a favourite field of study for anatomists; but notwithstanding the time and labour devoted to its study by a large number of eminent observers, and the volumes written on its structure, we are still far removed from a distinct understanding of many essential points in its anatomy.

Thus, although the rods and cones of the retina are now almost universally believed to be a sensory epithelium analogous to that found in the inner ear and in the mucous membrane of the nose, and that they are, therefore, the organs on which the images formed by the lenticular apparatus of the eye are projected and received, nevertheless no microscopist claims to have been able to demonstrate the course of any individual nerve-fibre of the retina through its various layers to its termination in any rod or cone; and lately Hannover,[1] who has devoted years to the study of the subject, denies positively that they form any part of the nervous system. We, therefore, believe that every careful study of its structure will be welcomed by all observers, and herewith submit a short account of the appearances presented by some of the inner layers of the human retina.

The retinæ used for study were removed from a young subject, who died of phthisis pulmonalis, and were, therefore, probably healthy, and were removed within four hours after death, and the results thus obtained have been in their main points confirmed by the examination of the posterior halves of eyes (immediately after enucleation), which had been removed on account of disease of the ciliary region.

The Internal Limiting Membrane.—Where such eyes have been opened by an equatorial section, and after removal of the vitreous, the retina *in situ* submitted to the action of a quarter per cent. solution of nitrate of silver, we have found on carefully raising the retina and laying it out in glycerine on a glass slide the following appearances:—

Starting at the entrance of the optic nerve we find the surface of the retina everywhere subdivided by sharp cut black lines, which are evidently the boundaries of flat epithelioid cells. In many cells the protoplasm appears to be finely granular, and some have a distinct, large, round, or oval nucleus. In some places these cells are broad and irregularly polygonal; in others long and narrow, radiating apparently from stomata similar to those observed in the endothelium of serous membranes. We have never in any given specimen been able to follow these cells more than four or five disc diameters from the disc (they often are well preserved on the macular side of this disc), although they probably form a continuous layer over the whole retina. A good representation of them is given in Fig. 1.

Focussing deeper in the preparation we encounter another set of silver lines, which, in varying shape, can always be easily traced over the entire retina. At the margin of the disk, and at the macula they are extremely fine, and inclose small and most irregularly shaped spaces, while in the periphery of the retina the fields inclosed by them are larger and often arranged in whorls, in places more or less resembling the arrangement of an endothelium with stomata. They are always narrower and more elongated over the large bloodvessels. These are evidently identical with the appearances described and figured by Schultze,[1] Retzius,[2] and Schwalbe.[3]

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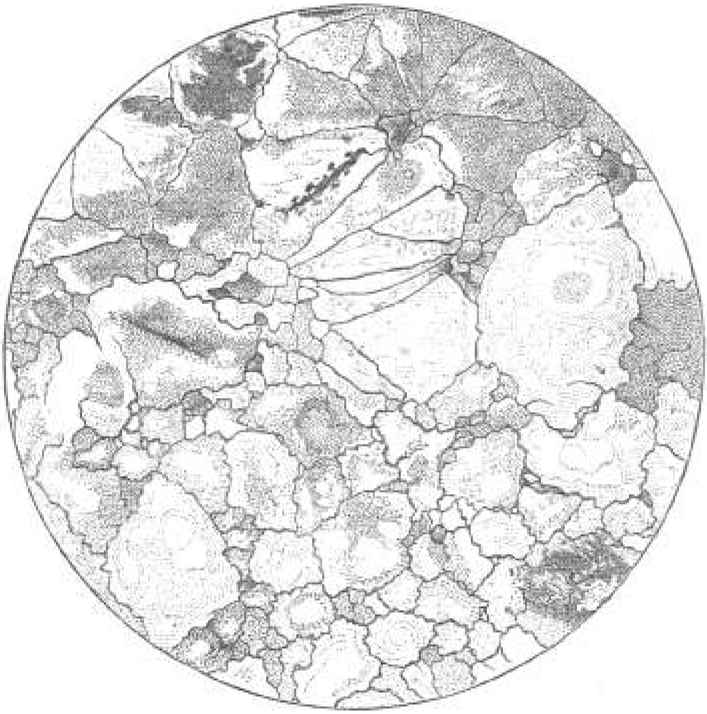
[1] La Rétine de l'Homme et des Vertebrés, par Adolphe Hannover, Copenhagen, 1876.

Fig. 1.



Endothelial cells covering inner surface of human retina near optic disk. Markings not essentially different from those upon serous membranes after treatment with silver. *a.* Large, slightly granular endothelial plate containing a characteristic oval nucleus. Preparation silver treated; Hart. Obj. v. Tube out and camera ocular.

The last-mentioned authors deny (as does also Merkel[4]) the presence of any other endothelial-like markings on the surface of the retina. We think that the first described large cells (Fig. 1) with their well-marked protoplasma and nuclei, seen *in situ* above the other smaller markings, present to every impartial observer all the essential characteristics of an endothelium, and herein we agree with the conclusions previously arrived at by Evarts and

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[1] Virchow's Archiv, vol. xxviii. pp. 482–489.

[2] Nordiskt Mediciniskt Arkiv, vol. iii., No. 4, and vol. iii., No. 2 (quoted by Schwalbe).

[3] Græfe und Saemisch, Handbuch der Augenheilkunde, vol i. pp. 369–374.

[4] Klinische Monatsblätter für Augenheilkunde, 1877, pp. 222–223.

Thin.[1] This endothelium presents, with its marked outlines of protoplasm and nuclei, such characteristic appearances that they cannot in any way be confounded with any accidental silver markings. Besides, they present similar appearances in all fresh specimens thus treated, and the same flat cells with their well-marked nuclei may also occasionally be demonstrated by other modes of preparation, sometimes even in diseased eyes. Thus we possess a logwood-stained section of a glaucomatous eye in which they may be seen on the fibre-layer near the disk, and also a section of an eye affected with retinitis pigmentosa, in which a few of these cells with their well-marked carmine-stained nucleus still adhere to the surface of the retina.

Moreover, Hannover[2] has repeatedly seen them in the fresh mammalian retina without any reagent having been employed, and describes them as six-sided cells with a round nucleus.

Concerning the nature of the silver markings identical with those of Schultze, Retzius, and Schwalbe, we cannot agree upon an opinion.

The Nerve-fibre Layer, with its arrangement in anastomosing bundles is beautifully shown by the same method of preparation, but we have nothing essential concerning it to add to the careful descriptions of Schwalbe and Michel.

The Layer of Ganglion Cells.—By still deeper focussing on the same preparations we obtain admirable views of this layer. As is well known, these cells vary very much in size, and are superposed in several layers at the macula lutea, while they form in most other situations a single layer; but while the pictures of this region, published by Hannover, show them still present two to three layers deep at the bottom of the fovea centralis, our preparations show that they gradually die out as they descend the sides of the pit, and in one admirable preparation of this region we have at the very bottom of the pit found only one layer, and in its exact centre a space sufficient for two ordinary sized ganglion cells, in which none could be demonstrated.[3]

The ganglion cells at the macula are usually described as bipolar, but as seen *in situ* by the above method they appear round or oval, sometimes with projections at one end, more rarely at both ends of the cell which, however, can be traced only at very slight distances. With a low power they almost look as if they lay in alveoli with marked walls, but on examining these interspaces with a higher power, the intercellular substance is seen to be resolved into a mass of very fine fibrillæ, which are probably nerve-fibres (Fig. 2).

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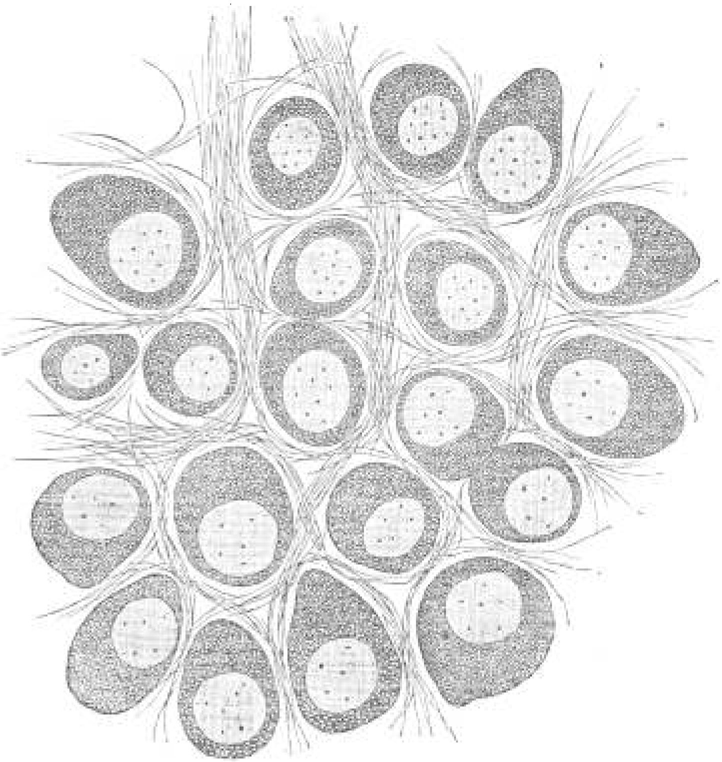
[1] Preliminary note on an Epithelial Arrangement in Front of the Retina. Journ. Anat. and Physiol., vol. viii. pp. 353–357. Notes on the Minute Structure of the Retina and Vitreous Humour.—J. C. Ewart. Ibid., vol. ix. pp. 166–168. On the Structure of the Retina.—J. C. Ewart and G. Thin. Ibid., vol. i. pp. 96–108.

[2] Op. cit., p. 129.

[3] H. Müller, Gerammelte Schriften, p. 111, states that at the bottom of the fovea there are still two to three rows of ganglion cells; Henle, Anatomie, vol. ii. p. 667, thinks that the macula everywhere "except perhaps at the very bottom of the fovea centralis" contains at least two to three layers; Schwalbe (Græfe and Saemisch, Handbuch der Augenheilkunde, vol. i. p. 431) says "that on this point literature furnishes the most contradictory assertions, but it is certain that the layer of ganglion cells never entirely disappears, and as shown by Henle, it here unites with the inner granule layer."

Fig. 2.

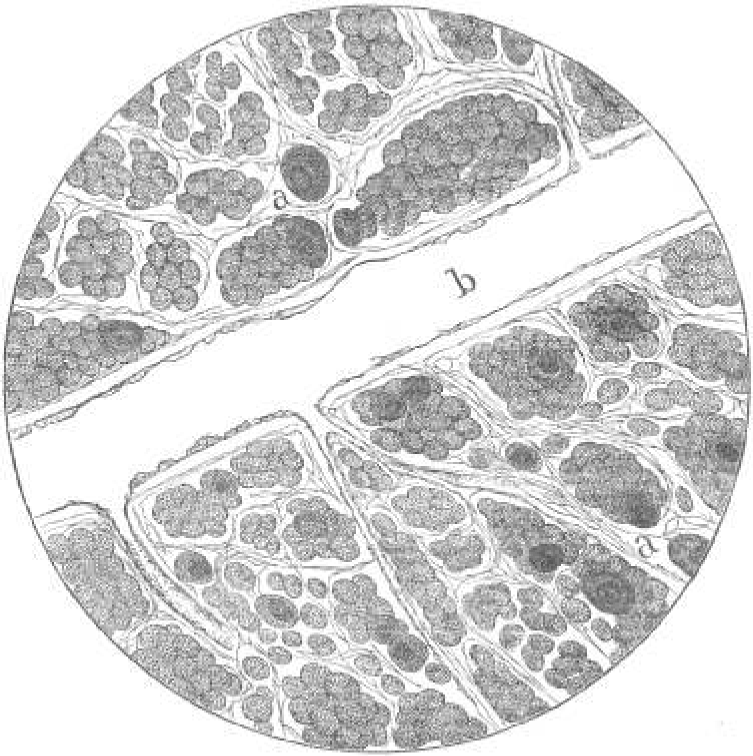


Arrangement of ganglion cells and nerve fibres near centre of fovea centralis retinæ. Human. Silver treated ; Hart. Obj. xi. à im. Tube out and camera ocular.

In examining the equatorial region of the retina we find that the cells of this layer present most marked varieties in size and appearance. They are here arranged in a single layer, and with a low power appear as if arranged in islands separated by clear lymph channels. Examination with a higher power shows that these channels are occupied by fine capillary vessels, by lymph channels, and by multitudes of exceedingly fine fibres (nerve-fibres?).

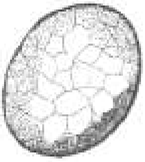
As seen in nitrate of silver preparations the larger cells present the appearance of the ganglion cells of the spinal cord with large nucleus and nucleolus and granular protoplasm, while the smaller ones are invariably stained much deeper by the silver, and in most of them no nucleus is perceptible. This difference in appearance and size of the cells is also seen in specimens double stained by carmine and indigo carmine,[1] but by this method the nuclei are readily demonstrated in the smaller cells, which much resemble the small nuclear elements in the cortical layers of the cerebellum.

Fig. 3.



Shows arrangement of cells of ganglion layer into island groups separated by spaces sometimes containing blood and lymph capillaries and bundles of nerve fibres. Many islands contain one or more large typical ganglion cells (*a*), while the remainder of the cells in the group are the small cells mentioned in the context. Often no large ganglion cell can be seen in a group. *b*. An arteriole which gives off capillary branches running between the islands. Hart. Obj. viii. Tube out and camera ocular.

Fig. 4.



Shows markings on large ganglion cell after silver treatment, probably indicating boundaries between small endothelial plates. This cell is in direct communication with a lymph passage showing silver markings. Hart. xi. à im. Tube out and camera ocular.

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[1] A New Method of Double Staining, Norris and Shakespeare, Amer. Journ. Med. Sci., Jan. 1877.

The marked difference in structure and size of these cells would seem to point to a probable difference of function. Figure 3 gives a good view of the appearances of the ganglion cells in the equatorial region of the retina, and of their grouping into islands. In a few of the large ganglion cells careful study with immersion lenses shows a very faint set of lines covering the surface of the cell, inclosing very minute irregularly polygonal areas, suggesting the idea of a possible endothelial covering of the cell. A view of these appearances is presented in Fig. 4.

ARTICLE IX.

CASE OF PEMPHIGUS MALIGNUS, IN WHICH ARSENIC TWICE APPEARED TO SAVE LIFE.

By L. DUNCAN BULKLEY, A.M., M.D., Physician to the Skin Department, Demilt Dispensary, New York; Attending Physician for Skin Diseases at the Out-Patient Department of the New York Hospital, etc.

THE case here reported is of especial interest, because on two occasions death, which seemed imminent in the opinion of a number of physicians who saw the case, was very clearly averted by the internal use of arsenic alone, without the aid of any other agent whatever. It is here presented in order to bring as forcibly as possible before the profession the great—if, indeed, it is not a specific—power which arsenic has over pemphigus; for, although this claim has been urged by Jonathan Hutchinson, of London, it has by no means become generally known and recognized to be true in the medical teachings and practice of the day.

Positivisms are so few in number in therapeutics that each accession to the list should be welcomed and duly prized, none the less because it relates to one of the more rare diseases. On a former occasion[1] I had the pleasure of emphasizing the almost specific action of ergot in controlling purpura, a point which I have verified many times since that report; and now I would wish to rank the effect of arsenic in pemphigus by the side of such therapeutical positivisms as that of mercury in syphilis, quinia in malaria, and ergot in purpura.

Pemphigus is, of course, a rare disease, seldom seen even by the specialist, but its acknowledged obstinacy and occasional fatality should lead each one to charge the mind with the fact that on good authority we may believe that arsenic will control it, if properly administered, in a great proportion of the cases. Hutchinson has written repeatedly on the subject, and several have confirmed his experience very fully. I have seen the same beneficial effects from arsenic in four other patients with pemphigus, whom I observed carefully in private practice, which need not be

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[1] Practitioner, November, 1876.